

# HAPTIC-SENSE-GENERATION INPUT DEVICE THAT IS REDUCED IN SIZE BY A GEAR MECHANISM

## BACKGROUND OF THE INVENTION

### [0001] 1. Field of the Invention

[0002] The present invention relates to a haptic-sense-generation input device that is particularly suitable for use in vehicles.

### [0003] 2. Description of the Related Art

[0004] FIG. 8 shows a conventional haptic-sense-generation input device in which the main part is shown in cross section. FIG. 9 is a sectional view taken along line 9-9 in FIG. 8.

[0005] A body 51 is a generally rectangular parallelepiped box made of a synthetic resin and is formed by molding. The body 51 is composed of a circumferential side wall 51a, a top wall 51b that is provided above the side wall 51a, a circular opening 51c that is formed in the top wall 51b, a first holding portion 51d that projects inward from the top wall 51b, a bottom wall 51e that is provided below the side wall 51a, and a generally cylindrical second holding portion 51f that extends inward from the bottom wall 51e.

[0006] The opening 51c and the second holding portion 51f are opposed to each other. The body 51 has a relatively large volume.

[0007] A motor 52 has a generally cylindrical base portion 52a and a motor shaft 52b that projects from the base portion 52a. The motor 52 is provided in such a manner that a rear portion of the base portion 52a is housed in and held by the second holding portion 51f and the motor shaft 52b projects outward through the opening 51c. The motor 52 is of a large size because it is required to generate a prescribed, relatively high torque.

[0008] A manipulation knob 53 is made of a synthetic resin and is formed by molding. The manipulation knob 53 is composed of a generally cylindrical manipulating portion 53a, a cylindrical fixing portion 53b that is provided inside the manipulating portion 53a and projects from the center of the manipulating portion 53a, an annular brim 53c that extends outward from the bottom of the manipulating portion 53a perpendicularly to the axis of the fixing portion 53b, and a cylindrical first pulley 53d that extends from a radial position, close to its outer periphery, of the brim 53c so as to be concentric with the fixing portion 53b.

[0009] The motor shaft 52b of the motor 52 is directly inserted in the cylindrical fixing portion 53b of the manipulation knob 53, and the motor shaft 52b is fixed to the fixing portion 53b by press fitting or screwing, for example.

[0010] When the manipulation knob 53 is attached, the manipulating portion 53a and the brim 53c are located outside the body 51 and the first pulley 53d is located inside the body 51.

[0011] A coding member 54 is composed of a disc-shaped rotator 54a, a support shaft 54b that penetrates through the center of the rotator 54a and extends in the vertical direction that is perpendicular to the rotator 54a, a plurality of slits 54c that are formed in the rotator 54a so as to be arranged concentrically with the support shaft 54b, and a disc-shaped

second pulley 54d that extends from a prescribed position of the support shaft 54b parallel with the rotator 54a.

[0012] One end portion of the support shaft 54b of the coding member 54 is rotatably attached to the first holding portion 51d of the body 51, whereby the rotator 54a can rotate. In this state, the support shaft 54b of the coding member 54 is parallel with the motor shaft 52b of the motor 52 and the second pulley 54d of the coding member 54 is flush with the first pulley 53d of the manipulation knob 53.

[0013] A photointerrupter 56 has a light-emitting element 56a and a photodetector 56b, and has a function that light that is emitted by the light-emitting element 56a is detected by the photodetector 56b. The photointerrupter 56 is provided in such a manner that the rotator 54a having the slits 54c is interposed between the light-emitting element 56a and the photodetector 56b. As the rotator 54a rotates, the photodetector 56a intermittently detects light that is emitted by the light-emitting element 56a.

[0014] That is, the photointerrupter 56 and the coding member 54 constitute a rotation detecting means for detecting a rotation angle of the manipulation knob 53.

[0015] A belt 55 is made of elastic rubber or a metal and has a ring shape. The belt 55 is wound on the first pulley 53d and the second pulley 54d, whereby the first pulley 53d and the second pulley 54d rotate in link with each other. That is, the belt 55 causes the motor shaft 53b of the motor 52 and the rotator 54a of the coding member 54 to rotate in link with each other.

[0016] A push-button switch 57 is composed of a base portion 57a and a push button 57b that projects from the base portion 57a. The push-button switch 57 is provided close to the motor 52 at such a position that the push button 57b is opposed to a tip portion of the first pulley 53d of the manipulation knob 53. When the first pulley 53d is manipulated in the axial direction, the push-button switch 57 is pushed (manipulated) by the tip portion of the first pulley 53d. That is, when the manipulation knob 53 is depressed in the axial direction, it is moved in the axial direction together with the motor shaft 52b, whereby the push-button switch 57 is manipulated.

[0017] A controller 58, which is a central processing unit (CPU), for example, produces a prescribed output signal when receiving a prescribed input signal. The output signal is used for controlling a haptic sense that is generated by the motor 52.

[0018] For example, when a proper output signal is output from the controller 58, the motor shaft 52b of the motor 52 is driven so as to produce a desired haptic sense. The haptic sense that is transmitted to the manipulation knob 53 can be changed depending on how the motor shaft 52b is driven.

[0019] Function selection switches 59 are a plurality of push-button switches, for example. A desired function can be selected by manipulating one of the push-button switches.

[0020] Output signals of the respective function switches 59 are input to the controller 58. For example, by using the function selection switches 59, selection can be made among such functions as tuning of a radio receiver, song selection of a compact disc (CD) player, and route setting of a